

WHAT IS CLAIMED IS:

- 1 1. A system for forming a cardiac muscle construct, comprising:
2 a substrate; and
3 cardiac cells provided on the substrate in the absence of a scaffold,
4 the cardiac cells cultured *in vitro* under conditions to allow the cells to become
5 confluent and detach from the substrate to form a three-dimensional cardiac muscle
6 construct.
- 1 2. The system according to claim 1, wherein the cardiac cells self-
2 organize to form the three-dimensional cardiac muscle construct.
- 1 3. The system according to claim 1, wherein the cardiac cells include
2 cardiac myocytes.
- 1 4. The system according to claim 1, wherein the cardiac cells include
2 fibroblasts.
- 1 5. The system according to claim 1, wherein the cardiac muscle
2 construct is spontaneously contractile.
- 1 6. The system according to claim 1, wherein the cardiac muscle
2 construct is responsive to electrical stimuli.
- 1 7. The system according to claim 1, wherein the cardiac muscle
2 construct is responsive to chemical stimuli.
- 1 8. The system according to claim 1, wherein the cardiac muscle
2 construct is resistant to fatigue.
- 1 9. The system according to claim 1, further comprising at least two
2 anchors secured to the substrate in spaced relationship with at least some of the
cardiac cells in contact with and attachable to the anchors.

1 10. The system according to claim 9, wherein the anchors include
2 silk suture segments coated with cell adhesion molecules.

1 11. The system according to claim 10, wherein the cell adhesion
2 molecules include laminin.

1 12. The system according to claim 1, wherein the substrate is coated
2 with cell adhesion molecules.

1 13. The system according to claim 12, wherein the cell adhesion
2 molecules include laminin.

1 14. The system according to claim 13, wherein the concentration of
2 laminin is about 0.4 to 2.0 $\mu\text{g}/\text{cm}^2$.

3 15. The system according to claim 1, wherein the cardiac muscle
4 construct is substantially cylindrical.

1 16. The system according to claim 1, further comprising skeletal
2 muscle cells cultured in combination with the cardiac cells.

1 17. A method for forming a cardiac muscle construct, comprising:
2 providing a scaffold-free substrate;
3 providing cardiac cells on the substrate; and
4 culturing the cardiac cells *in vitro* under conditions to allow the cells
5 to become confluent and detach from the substrate to form a three-dimensional
6 cardiac muscle construct.

1 18. The method according to claim 17, wherein providing cardiac
2 cells includes providing cardiac myocytes.

1 19. The method according to claim 17, wherein providing cardiac
 cells includes providing fibroblasts.

1 20. The method according to claim 17, further comprising eliciting
2 a response of the cardiac muscle construct to electrical stimuli.

1 21. The system according to claim 17, further comprising eliciting
2 a response of the cardiac muscle construct to chemical stimuli.

1 22. The method according to claim 17, further comprising securing
2 at least two anchors to the substrate in spaced relationship with at least some of the
3 cardiac cells in contact with the and attachable to the anchors.

1 23. The method according to claim 22, wherein the anchors include
2 silk suture segments coated with cell adhesion molecules.

1 24. The method according to claim 23, wherein the cell adhesion
2 molecules include laminin.

1 25. The method according to claim 17, further comprising coating
2 the substrate with cell adhesion molecules.

1 26. The method according to claim 25, wherein the cell adhesion
2 molecules include laminin.

1 27. The method according to claim 26, wherein the concentration of
2 laminin is about 0.4 to 2.0 $\mu\text{g}/\text{cm}^2$.

1 28. The method according to claim 17, further comprising measuring
2 a functional property of the cardiac muscle construct and using the measured
3 property as feedback to control the formation of the cardiac muscle construct.

1 29. The method according to claim 17, further comprising culturing
2 skeletal muscle cells in combination with the cardiac cells.

1 30. The method according to claim 17, further including implanting
2 the cardiac muscle construct in a suitable recipient.

1 31. The method according to claim 17, further including wrapping
2 an acellularized aorta with a layer of cardiac cells.

1 32. A cardiac muscle construct, comprising:
2 cardiac myocytes provided on a scaffold-free substrate, the cardiac
3 myocytes cultured *in vitro* under conditions to allow the myocytes to self-organize
4 and become a confluent monolayer, the monolayer detaching from the substrate to
5 form a three-dimensional cardiac muscle construct.

1 33. The cardiac muscle construct according to claim 32, further
2 comprising fibroblasts provided in combination with the cardiac myocytes.

1 34. The cardiac muscle construct according to claim 32, wherein the
2 construct is spontaneously contractile.

1 35. The cardiac muscle construct according to claim 32, wherein the
2 construct is responsive to electrical stimuli.

1 36. The cardiac muscle construct according to claim 32, wherein the
2 construct is responsive to chemical stimuli.

1 37. The cardiac muscle construct according to claim 32, wherein the
2 construct is resistant to fatigue.

1 38. The cardiac muscle construct according to claim 32, wherein the
2 construct includes adherens junctions formed between the cardiac myocytes.

1 39. The cardiac muscle construct according to claim 32, wherein the
2 construct includes gap junctions between the cardiac myocytes.

- 1 40. The cardiac muscle construct according to claim 32, wherein the
- 2 cardiac muscle construct is substantially cylindrical.